

US Caribbean Summit to Sea Characterization

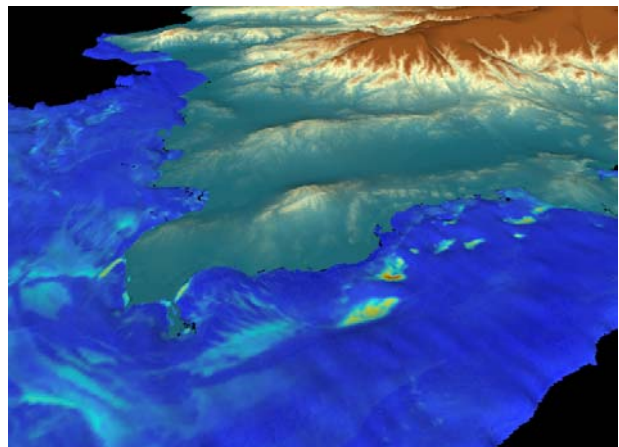
Objectives:

Develop an inexpensive, simple, GIS-based tool that uses satellite imagery and other data to support the assessment and management of land-based sources of pollution and affected shallow-water coral reef ecosystems. Provide the tool to local coastal zone managers and resource managers to improve conservation and management of terrestrial and marine resources. Explore the spatial linkages between changes in coral reef ecosystems and land use change, and land-based sources of pollution.

Project Summary:

This project serves to provide spatial data products for better coral monitoring in the U.S. Caribbean and addressing the effects of the land based sources of pollution and land use change on near shore coral reefs in the U.S. Caribbean Continuous summit-to-sea maps, including digital elevation and satellite derived bathymetry, satellite derived land cover and benthic habitats, watershed delineations, outflow points, coral reef change analyses are available to the public, in addition to raw and processed Landsat imagery. This project highlights specific watersheds and terrestrial areas that are most likely to contribute land-based sediments and pollutants to near shore coral reefs because of their location, terrain and cover.

The project emphasized the development and application of marine ecosystem change analysis methodologies. The GIS-based tool uses GIS to spatially and temporally link moderate and low resolution satellite imagery and monitoring data to: 1) provide tools to better manage land and coral reef ecosystems; and 2) determine whether or not these technologies can provide data adequate for answering management questions. The methodologies and tools will be developed, tested, and evaluated by local Agency resource managers in Puerto Rico and the US Virgin Islands. The project also will focus on working with resource managers and scientists in Puerto Rico and the U.S. Virgin Islands to use the GIS-based tool in their coastal zone management and other resource management and decision making activities.



An example of the raw and value-added products for Western Puerto Rico (digital elevation merged with a benthic map of the Getis statistic, a measure of spatial auto-correlation, which is a proxy for coral complexity, or habitat quality).

Background:

Satellite imagery, especially low-cost Landsat Thematic Mapper imagery can provide essential data to scientists and coastal managers working to assess and conserve coastal habitats, and most importantly to mitigate the effects of land-based sources of pollution on marine resources. The Landsat imagery archive has provided a wealth of available data, useful for studying trends in marine systems as well as on land.

The Center for Coastal Monitoring and Assessment's Biogeography team has collected a series of Landsat images for benthic mapping and change detection for Puerto Rico and the U.S. Virgin Islands from 1986-2003, as well as 1990, 2000 and 2003 imagery for Jamaica and Belize. Summit-to-Sea terrain maps were derived from the satellite data, and allow users to visualize elevation and bathymetry in one continuous layer. This surface is also being used to model how contaminants travel on land. Land-based sources of pollution accumulate in rivers and streams, which then lead to nearby coral reefs. Sediment delivery at river mouths for several time periods between 1985 and 2000 were derived using a modified soil erosion equation was determined at outflow points for each elevation-derived watershed. These proxies help locate land areas that are particularly threatening coral reefs under various land cover and precipitation scenarios.

Summit-to-Sea cover maps have also been created for each study area by merging available land cover with benthic habitats to provide valuable information about the land/sea interface, and what types of land cover in coastal areas may be affecting the marine environment.

Finally, successive Landsat images are being analyzed to detect areas of pollution and sedimentation plumes. Areas of significant land use change, and watersheds with high sediment delivery have been identified in terrestrial areas upstream of hotspots of change in coral reef ecosystem determined by satellite change detection methods, and spatial statistics used as proxies for coral complexity and habitat quality, indicating a possible link between land-based sources of pollution, and other likely threats to downstream coral reefs. This type of satellite monitoring project are critical for identifying the sources of negative influences from terrestrial systems, and needs to become a fundamental component of coral reef monitoring and conservation in Puerto Rico, the U.S.V.I and the greater Caribbean.

Products include:

- ortho-rectified Landsat imagery for all study areas, including Puerto Rico, USVI, Jamaica, and Belize.
- estimated depth derived from Landsat imagery
- land-water-cloud-shadow masks for each Landsat image
- at-satellite reflectance and water reflectance for every Landsat image
- digital elevation models and watershed maps
- change detection maps showing areas of increased sedimentation, homogeneity in the reef systems around Puerto Rico and the U.S. Virgin Islands. In addition, general trends in water quality and sediment delivery by watershed are available.

Partners:

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World Resources Institute (WRI)
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USGS – U.S. Geological Survey
NASA – National Aeronautics and Space Administration
NCRI – National Coral Reef Institute
UWI – University of the West Indies, Mona, Jamaica

Relevant Links:

<http://www.Reefbase.org> – a Global Information System on Coral Reefs
<http://reefsatrisk.wri.org/> - World Resources Institute: Reefs at Risk
<http://glcf.umiacs.umd.edu/index.shtml> - Global Land Cover Facility
<http://eol.jsc.nasa.gov/Reefs/default.htm> - Remote Sensing of Coral Reefs at NASA
<http://www.ccdc.org.jm/> - the Caribbean Coastal Data Center
<http://imars.usf.edu/corals/imagedb.html> - Institute for Marine Remote Sensing (ImaRS)

Time Frame:

2001 – Present

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